RA IV Hurricane Committee
Fortieth Session
Fort de France, Martinique
9-13 April 2018
1. ORGANIZATION OF THE SESSION

At the kind invitation of the Government of France, the fortieth session of the WMO Regional Association (RA) IV Hurricane Committee was held in Fort de France, Martinique from 9 to 13 April 2018.

The inauguration ceremony for the meeting took place at 9:00 am Monday 9 April 2018, and it included the following speakers:

1) Mr Franck Robine, Prefect, Martinique et Zone de Défense Antilles.
2) Mr François Lalaurette, Head of Forecast Operations at Météo-France, representing Mr Jean-Marc Lacave, Permanent Representative of France
3) Dr Taoyong Peng, Chief, Tropical Cyclone Programme Division, World Meteorological Organization,
4) Mr Juan Carlos Fallas Sojo, Permanent Representative of Costa Rica with WMO and President of WMO RA IV,
5) Dr Lixion Avila, on behalf of Mr Kenneth Graham, Chair of the WMO RA IV Hurricane Committee, and
6) Mr Louis Boutrin, Executive Councilor, Collectivité de Martinique.

1.1 Opening of the session

1.1.1 Mr François Lalaurette, Head of Forecast Operations at Météo-France, representing Mr Jean-Marc Lacave, Permanent Representative of France, said that France hosted this event for the second time and it is the first time France has been hit by two category 5 hurricanes, which lead to an unbearable affect on human lives and properties. Cooperation is already very strong in RA-IV and must be strengthened further and it was an honor to welcome this session. It was also an opportunity to present different digital systems to be implemented in France. He welcomed the participants and wished a fruitful session in Martinique.

1.1.2 On behalf of Prof. Petteri Taalas, the Secretary-General of World Meteorological Organization (WMO), Dr Taoyong Peng, Chief, Tropical Cyclone Programme (TCP) Division of WMO, welcomed all the participants and expressed WMO’s appreciation and gratitude to the Government of France for hosting the fortieth session of the Hurricane Committee in Martinique. He highlighted that tropical cyclone season in 2017 was particularly active with 50% more hurricanes and double the number major hurricanes (category 3 and above) in Atlantic as compared to long-term average.

As a community specialized in tropical cyclones (hurricanes) we must be prepared and vigilant at all times and make the most of advances in science and technology into operational services. He reminded the Committee that in general 70% of natural disasters are of meteorological in nature, and 70% of those meteorological disasters were associated with tropical cyclones in most countries prone to tropical cyclones. This showed how important tropical cyclones can be and how significant the WMO Tropical Cyclone Programme (TCP) has been. Dr. Peng also informed the Committee that WMO was planning to develop a service information system (Common Interface for Service Delivery, CISD) including WMO GMAS to provide authoritative forecasting and warning information to serve all stakeholders concerned, and global community as a whole.

He wished all the participants a very successful and productive session over the next five days and looked forward to the fruitful outcome of their deliberations.

1.1.3 Mr Juan Carlos Fallas Sojo, Permanent Representative of Costa Rica with the World Meteorological Organization and president of RA-IV inaugurated the fortieth session of the
Hurricane Committee and announced that the new Chairperson of the Committee would be Mr Kenneth Graham, the new director of the National Hurricane Center.

He noted that all of the members were anxious to learn about the experiences of each of the Member countries during one of the most intense tropical cyclone seasons of recent decades.

There was a wealth of new information, but what was important for us was to share and apply the lessons learned so that we may have an even greater understanding of the environment around us in order to provide the best scientific support and most relevant information to the decision-makers.

Over the years, we have learned that warnings and predictions must have three key features: they must be timely, accurate and current. The credibility and prestige of a meteorological service depends on its capacity to provide not only useful, secure services to the public, adapted to the needs of each community and town, but also the best communication channels – social networks and the myriad digital platforms – and these must be increasingly more effective, personalized, modern and within the reach of every user. Today’s users no longer merely consume information; they have become information prosumers.

In the 2017 season, tracking the tropical cyclones affecting the Region was of vital importance. However, there was still much more to do; sometimes, the magnitude of the destruction cannot be comprehended fully until it was experienced first-hand. Every year, countries were under the constant threat of meteorological hazards, and meteorological services must continually improve their preparation. The work in the Committee was, and would continue to be, of vital importance. Services must remain eager to do more research, to dig deeper, to share the knowledge of the meteorological sciences, as shown in the search for a greater understanding of tropical cyclones, to benefit our sister nations.

The Committee’s contribution was much more than a meeting to exchange knowledge. It was like the Guanacaste tree, indigenous to the North Pacific of Costa Rica, a tree which was not only extraordinarily beautiful, but is shaped like a great umbrella, and so provides protection from both the intense sun and the rain, and its wood is used to produce artisanal furniture of great beauty. In the same way, the RA IV Hurricane Committee was like a great, leafy tree, shading all our nations, and that its “wood”, the product of each discussion, would allow us to lay the foundations to improve the security and well-being of all the inhabitants of our beloved Region.

Mr Fallas dedicated a few words of thanks to Mr Tyrone Sutherland in honour of his upcoming retirement, and hoped that he would continue collaborating with the Committee in the future. He concluded his remarks by wishing the Committee every success in its efforts, planning and knowledge acquisition, and thanked Martinique for its kindness in hosting this session.

1.1.4 Dr Lixion Avila, on behalf of Mr Kenneth Graham, Chairman of the RA IV Hurricane Committee, thanked the Government of France and Météo France for hosting the meeting and he expressed his sentiments to colleagues who were adversely affected by the 2017 tropical cyclones.

1.1.5 Mr Louis Boutrin, Executive Councilor, Collectivité de Martinique, in charge of natural risks spoke about solving issues over the last years. Conventions and framework have been signed to protect communities and he underlines the significant role of Météo-France. He presented different systems implemented in Martinique. In terms of prevention, he mentions that all are exposed to natural hazards.
It was stated that France was providing logistic support to the communities in need and to populations affected by Irma. He wished all the participants a very successful and productive session.

1.1.6 Mr Franck Robine, Prefect, Martinique et Zone de Défense Antilles, welcomed the participants and indicated that the Caribbean have experienced a very intense season. It has been a period which obliged countries to work together under pressure and the work of the members of the Committee was invaluable in this sense. The international cooperation was much appreciated and there would be a before and after Irma and Maria. Skills would have to be developed in order to act and protect and sensitize the populations and the forecasting plans reviewed.

1.1.7 The session was attended by 51 participants, representing 26 RA IV Member States of the Committee, with observers from Spain, Cape Verde and Caribbean Institute of Meteorology and Hydrology (CIMH). The list of participants is given in Appendix I.

1.2 Adoption of the agenda

The Committee adopted the agenda for the session as given in Appendix II.

1.3 Working arrangements for the session

The Committee decided on its working hours and the arrangements for the session, Vice chairs were confirmed (Mr Meade and Dr Rubiera). Vice chairs acted as Chairs during the first two days of the session.

2. REPORT OF THE CHAIRMAN OF THE COMMITTEE

2.1 Mr Kenneth Graham has been selected Director of the NOAA National Hurricane Center/RSMC Miami, and would be the Chairperson of the WMO RAIV Hurricane Committee.

2.2 The WMO/RSMC Miami attachment program continued in 2017 with participants from Belize, Canada, France, and Mexico. This program helps hurricane warning coordination in the region during tropical cyclone events while meteorologists from the region gain valuable training in hurricane forecasting. RSMC Miami and WMO strongly encouraged WMO RA-IV Permanent Representatives to continue to support this program. The announcement requesting candidates for 2018 would be sent by the RA-IV President in late April or early May.

2.3 Reconnaissance aircraft continues to play an extremely important role in monitoring the track and intensity of tropical cyclones. During the very active 2017 season, the U.S. Air Force and NOAA Reconnaissance Hurricane aircraft flew a total of 134 missions, and provided valuable meteorological data not available from any other sources. These data helped to determine the intensity, location and structure of hurricanes that threatened or impacted land.

2.4 The agreement between RSMC Miami and the Mexican Air Force to coordinate reconnaissance hurricane flights over Mexican airspace continued in 2017. Meteorologists from the Mexican Air Force were stationed at the RSMC Miami, and helped coordinate timely clearances for hurricane surveillance and reconnaissance flights during tropical cyclone events that had the potential to affect Mexico. Their efforts helped improve the overall efficiency of the Hurricane Warning Program. The Chair urged the continuation of this program in 2018 and a letter of invitation has been sent to the Mexican Air Force.
2.5 The WMO RA-IV Workshop on Hurricane Forecasting and Warning and Public Weather Services was held at RSMC Miami 26 February - 9 March 2018. This year's workshop was conducted in English only due to the lack of funds. The Chair strongly requests that funds for this workshop become reallocated, and that the workshop continues to be offered in English, and also in Spanish every other year, due to the great importance to the region’s hurricane program.

2.6 RSMC Miami issued its first operational Storm Surge Watch and Warning for the continental United States in 2017 under the new storm surge watch and warning program. This Watch and Warning highlighted areas along and near the United States coasts that were at risk for life-threatening inundation from storm surge during the several hurricanes that affected the USA.

2.7 In 2017, RSMC Miami began publicly issuing forecast and tropical storm and hurricane watches and warnings for “Potential Tropical Cyclone” disturbances that had the potential of becoming a tropical cyclone and bringing tropical storm or hurricane force winds to land areas, generally within 36-48 hours. RSMC Miami issued Potential Tropical Cyclone advisories for these systems and successfully coordinated Watches and Warnings with the affected RA-IV Member States.

2.8 RSMC Miami issued experimentally for the first time in 2017 the “Most likely Time of Arrival” and the “Earliest Reasonable Arrival Time” of Tropical-Storm-Force Winds graphics. These graphics incorporated typical forecast uncertainty in the same manner that the current NHC wind speed probabilities account for track, intensity, and size uncertainties.

2.9 Through a partnership with Florida International University, the World Meteorological Organization, U.S. AID/OFDA, and the National Hurricane Center, a coastal inundation forecast demonstration project (CIFDP-C) continued to be developed in 2017 and was scheduled to be implemented in 2018. This CIFDP-C project which takes place in Hispaniola, provided the essential framework and support to establish new hydrodynamic forecasting activities within countries in RA IV. The project would deliver storm surge planning products and forecasting tools. There was potential for the project to be expanded to Mexico and Belize.

2.10 A meeting of the Severe Weather Demonstration Forecast Project (SWDFP) Expert Group took place in Miami during 23-26 May 2017. This meeting was aimed to better understand and specify the needs of the forecasters with regards to NWP and data sharing. It also continued to explore the relationship between entities in the region that would be involved in the SWFDP, and importantly, the relationship between these entities and the global and regional centers, including the RSMC-Miami. Representatives of NCEP, RSMC Miami, Canada, Météo-France as well as selected representatives of some NMHSs in the region, contributed to specific elements envisioned for the SWFDP.

2.11 The Latin America Caribbean Hurricane Awareness Tour (LACHAT) took place from 24 to 29 April 2017. The U.S. Air Force C-130 (J-model) Hurricane Hunter plane visited Merida, Mexico, San Pedro Sula, Honduras, Grand Cayman, Turk and Caicos, and Puerto Rico. At the request of the following countries, the 2018 LACHAT was scheduled to take place from 23 to 29 April stopping in La Paz and Manzanillo, Mexico; Panama City, Panama; Montego Bay, Jamaica; and Puerto Rico. This project increases public awareness of the hurricane threat and strengthens national and international teamwork for storm warning and emergency response. The LACHAT enhances the visibility of the participating country’s weather forecasting and emergency management offices. It is also noted that the 2017 NOAA Hurricane Awareness Tour took place from 7 to 12 May 2017 and included highly-successful stop in Gander, Canada.
2.12 RSMC Miami and the Chair greatly appreciated the radar imagery received operationally from RA-IV members during the hurricane season. The Chair encouraged NMHSs to continue to make radar imagery from the region available operationally via the Internet or any other possible way. Radar data from the Caribbean islands were extremely important in determining the evolution of the several hurricanes that moved across this region during 2017. The radar data also allowed RSMC Miami to provide additional position updates as the cyclones approached land.

2.13 Surface and upper air observations are very essential to the operational forecasts of the RSMC Miami. The Chair appreciated the members’ efforts to maintain their observation and communication systems, especially the data received from country members during, and before, and after tropical cyclone events. The incorporation of additional upper-air soundings helped to improve model forecasts during the 2017 hurricane season.

2.14 The Chair thanked the members affected by tropical cyclones for the submission of their post-storm country reports, primarily during the devastating hurricane season of 2017. It was emphasized that this information was vital to the preparation of the RSMC Miami Tropical Cyclone Reports. The Chair requested that members use the format stated in the operational hurricane plan approved by the region.

2.15 Coordination between RSMC Miami and the U.S. Department of State Crisis Operations Center would continue during hurricane events with the U.S. Embassies in the RA IV countries.

2.16 As part of the United States Weather Research Program (USWRP), the Joint Hurricane Testbed (JHT) was one of the primary avenues to evaluate research projects with the goal of transferring successful projects into operations.

2.17 The NOAA Hurricane Forecast Improvement Program (HFIP) is a multi-agency effort to improve tropical cyclone track and intensity forecasts. RSMC Miami remains actively involved in leading aspects of HFIP. The procedure whereby promising output was made available in real or near real time for the Specialists was in place. Promising output was made available in or near real time at: http://www.hfip.org/products/

3. REVIEW OF THE PAST HURRICANE SEASON

3.1 Summary of the past season

3.1.1 Dr Lixion Avila, from RSMC Miami, summarized the tropical cyclone activity during 2017 in the Atlantic Basin. There were 17 named storms, including 10 hurricanes, and 6 major hurricanes. This is the highest number of major hurricanes since 2005. He also noted that there were six category 5 hurricane landfalls across the Caribbean basin from Irma and Maria. This included three category 4 landfalls in the U.S. (Harvey, Irma, and Maria). There was discussion of the difficulties in the forecast process with so many hurricanes intensifying rapidly.

3.1.2 The East Pacific basin produced 18 named storms including 9 hurricanes and 4 major hurricanes. The number of named storms was above the long-term average of 15, while the number of hurricanes and major hurricanes was near the long-term averages of 8 and 4, respectively. There were also two tropical depressions that formed that did not reach tropical storm strength. Despite the large number of tropical storm that formed in 2017, many of them were weak, and/or, short-lived.
3.1.3 The detailed report on the 2017 hurricane season provided by the RSMC is given in Appendix III.

3.2 Reports on hurricanes, tropical storms, tropical disturbances and related flooding during 2017

3.2.1 Members provided the Committee with reports on the impact of tropical cyclones and other severe weather events in their respective countries during 2017.

3.2.2 Antigua and Barbuda, mostly Barbuda, was badly affected in 2017. Hurricane Irma created massive destruction across Barbuda leading to the evacuation of the entire island. Antigua though not as badly affected, reported roof damage, down trees and power lines. Hurricane Maria, and to a lesser extent Jose, seriously threatened the islands, heightening the fears and anxieties of the public and, further affected the islands with disruptions, strong winds and storm surge.

Hurricane Irma created massive destruction across Barbuda. Rainfall amounts of 1 to 3 inches were recorded across Antigua between 4pm (2000UTC) 5th and 2pm (1800UTC) on the 6th, September. Minimum atmospheric pressure recorded at the V.C Bird International Airport during the passage of Irma was 988.3 millibars or 29.18 inches, recorded on the 6th at 1am (0500UTC). This coincided with the time when the centre was observed by radar to be approaching or over Barbuda. Hurricane Maria lashed Antigua and Barbuda on the 18th of September with sustained storm force winds of up to 50 miles per hour, with gusts of over 60 miles per hour. Strong winds and powerful storm surges from Maria did further damage to many areas. Accumulated rainfall amounts of 3 to 4 inches were recorded across Antigua between 4pm (2000UTC) 18th and 8pm (2400UTC) 19th. Minimum atmospheric pressure recorded at the V.C Bird International Airport during the passage of Irma was 1005.2 millibars or 29.68 inches, recorded on the 19th at 4am (0800 UTC).

3.2.3 The British Caribbean Territories were particularly hard hit by the 2017 Hurricane Season. Hurricane Irma impacted Anguilla, the British Virgin Islands and the Turks and Caicos Islands, while Hurricane Maria added to the woes in the Turks and Caicos Islands.

3.2.4 The centre of Hurricane Irma passed within 7.5 miles (12km) of the nearest point of the southwestern tip of Anguilla on the morning of 6 September. An automatic weather station on the island reported a 10-minute average wind speed of 165 kt (190mph) (306 km/h). The damage caused by Irma in Anguilla was extensive and the southern and western sides of the islands suffered the worst of the damage. The island lost electrical power because of damage to the infrastructure, approximately 98% of the housing stock was damaged, and there was one death. The Government of Anguilla estimated that the total cost of physical damage was USD 290 million.

3.2.5 Ms Sharleen Dabreo, Director of the Department of Disaster Management of the British Virgin Islands, made a presentation on the season’s impacts on the British Virgin Islands (BVI). The presentation showed the “unprecedented trio” and the response of the BVI to a flood, Hurricane Irma and Hurricane Maria. After striking Anguilla, the centre of Hurricane Irma passed over Beef Island in the British Virgin Islands just after 1PM local time on 6 September with winds forecast to be 161kt (185mph) (298km/h). The Government of the British Virgin Islands indicated that Irma caused injury to 125 persons and there were 4 deaths. The estimated cost of the damage to the British Virgin Islands was USD 3.6 billion. In presenting these three events to the Committee, Ms Dabreo examined their impacts, the declaration of the state of emergency and the massive debris caused. She exposed the risk knowledge and the early warning system used in the BVI. She underlined the importance of managing disasters and she discussed challenges and lessons learned, recovery plans and future enhancements in the islands.
3.2.6 After devastating the British Virgin Islands on 6 September, Hurricane Irma approached the Turks and Caicos Islands on 7 September. At its closest point, the center of Hurricane Irma reached within 25 miles (40km) to the nearest island as a category 5 hurricane, with forecast winds initially of 152kt (175mph) (282 km/h), but then forecasted to decrease to 143kt (165mph) (265 km/h) as it closed in on West Caicos.

3.2.7 Although there were no deaths associated with Irma as its centre passed to the south of the Turks and Caicos Islands, there was damage to at least 70% of all the buildings. The most affected islands were Providenciales, Salt Cay, Grand Turk and South Caicos. These islands experienced extensive damage and a state of emergency was declared. There was also massive flooding, especially in Providenciales.

3.2.8 Hurricane Maria approached the Turks and Caicos on 22 September after causing catastrophic damage during the passage of its center over Puerto Rico. The center of Maria passed within 34 miles (55 kilometers) of the east coast of Grand Turk and caused further damage to Providenciales, Grand Turk, Salt Cay and South Caicos; but because of the earlier damage caused by Irma, Maria’s damage was not easy to ascertain.

3.2.9 Dr. Virginia Clerveaux, Director of the Turks and Caicos Islands Department of Disaster Management and Emergencies, reported on the impacts on those islands by both Irma and Maria. They were multi-island impacts. A graphic was shown with the percentage of impacts and the full extent of the devastation caused. Communication was essential, although sometimes it was difficult to communicate among the islands. This was the main challenge as the public demands faster information, more detailed and timely information and island-specific information. The Alerting System post-Irma (radio system affected, email messages from Bahamas Met Office) was also presented. Considering the lessons learnt and recommendations, there was a need for redundancy in TCI communications systems, with the TCI to consider establishing its own Meteorological Office and Doppler weather radar system, installation of weather systems in every island and the need for a review of its early warning system.

3.2.10 Bahamas presented the situation experienced in the country in a devastating season: alerts, evacuations. The news items and alerts issued were presented and graphs, pictures and a video were used to support the presentation.

3.2.11 The most direct impact on Barbados resulted from the passage of what was Tropical Storm Harvey at the time. Harvey was the 8th Tropical Cyclone of the 2017 Atlantic Hurricane Season and it affected Barbados and the central Lesser Antilles between the 17th and 18th August 2017.

3.2.12 Bermuda was not affected by anything more than some distant hurricane generated swells and occasionally elevated winds, noting that sustained tropical-storm-force winds never reached Bermuda. It was the first time in 10 years that the Bermuda Weather Service did not issue any tropical storm/hurricane watches/warnings during the season.

3.2.13 Canada indicated that despite the severity of the 2017 tropical cyclone season in the Atlantic and Caribbean Basins, Canada received only minor impacts. The Canadian Hurricane Centre (CHC) provided a full suite of products for 4 storms: Hurricane Gert; Potential Tropical Storm Ten; Hurricane Jose; and Hurricane Maria, with one information bulletin on Hurricane Nate. With Gert, Jose and Maria there were significant swell waves that reached the Atlantic-facing coastlines of Nova Scotia and Newfoundland measuring in general between 2 to 3 m from these systems with some higher swells of 3 to 4 m reaching the coastline of Nova Scotia with Jose. Storm-force winds were felt in the offshore marine environment with these tropical cyclones, but no impacts reported.
3.2.14 Colombia noted that in the Caribbean Sea, the presence and trajectory of two cyclonic systems were observed. The first of these systems was Hurricane Harvey, which circulated over the north of the eastern Caribbean Sea as a tropical storm; the second was Tropical Storm Nate, which started in the western Caribbean Sea and moved north-northeastward, reaching its maximum intensity over the Gulf of Mexico. These two systems indirectly affected the weather conditions of Colombia. Hurricane Harvey contributed to the advection of cloud cover and rainfall from the east to the centre of the country, generating strong winds and significant increases in swells in various areas in the central and eastern Colombian Caribbean Sea. Hurricane Nate impacted the Archipelago of San Andrés, Providencia and Santa Catalina, causing heavy rainfall, as well as gusts of wind in excess of 46 km/h and increased swells in areas in the northeast of the Archipelago.

3.2.15 Costa Rica described Nate’s trajectory as it developed from a low-pressure system to tropical depression No. 16. Two warnings were issued on 2 October, and the Emergency Operations Centre (EOC) was activated (in total, 28 warnings were issued, and the EOC was active for one month due to the impact of the system). Costa Rica spoke about the Central America Flash Flood Guidance system, a vital tool for dealing with the conditions (average soil moisture and landslide index). Nate caused more fatalities (13) than Hurricane Otto, it affected 76 of the country’s 82 cantons and resulted in losses of 500 million dollars, in addition to other significant consequences.

3.2.16 Cuba noted that it experienced three tropical cyclones during the season. Hurricane Nate affected Cuba indirectly as it passed through the Yucatán Channel, causing significant rainfall in the westernmost province of the country. Philippe affected Cuba as a tropical depression and also brought rainfall, this time in the central region of the country.

However, without a doubt, the strongest impact on Cuba occurred on 9 and 10 September, when Hurricane Irma struck with Category 5 intensity, decreasing to Category 4 as it crossed over the keys and the northern coast. Before the passage of Irma, 1,863,589 people were protected. In spite of the prevention measures taken, however, nine individuals lost their lives, mainly through their own neglect. There were 158,554 houses affected, 14,657 of which were totally destroyed. The electrical system collapsed throughout the country, although it was completely restored by the end of September. Tourist sites in the keys were severely impacted by the hurricane, but these areas recovered in record time and were providing service by the start of the tourist season. Property damage was estimated at around US$ 200 million.

3.2.17 Sint Maarten described the complicated situation experienced with the passage of Irma. Graphs and pictures supported the presentation and major damages and casualties were presented as well as evacuation action and cooperation initiatives.

3.2.18 Dominica, located in the main development region (MDR) for hurricanes MDR, is was especially vulnerable to hurricane impacts. Dominica presented the experience of Maria, the first category 5 hurricane to make landfall on the country. A history of major tropical cyclones that affected Dominica was also presented. Maria developed from a tropical wave and it intensified to a tropical storm and a tropical storm watch was issued. The system was later upgraded to a hurricane and a hurricane watch was issued followed by a warning. Maria intensified rapidly from a category 1 to a category 5 hurricane due to favourable conditions that included warm sea surface temperatures and low wind shear and the hurricane made a direct landfall on Dominica on September 18th. The speaker showed the extreme values recorded at selected stations with the passage of Maria as well as impacts in the country (catastrophic destruction to housing infrastructure, agriculture, etc. and a number of lives loss). The speaker thanked the various organizations and meteorological counterparts for their support and encouragement and stressed the need for assistance and collaboration as
Dominica cannot do it alone in its recovery efforts. The speaker also expressed best wishes in 2018 and beyond.

3.2.19 The Dominican Republic stated that during the 2017 cyclone season, in view of the warnings and alerts issued by the National Meteorological Office (Oficina Nacional de Meteorología (ONAMET)) due to the danger of Hurricanes Irma and Maria, the National Emergency Plan was activated under the coordination of the Regional Specialized Meteorological Centre in Miami.

The centre of Hurricane Irma moved close to the northern coast of the Dominican Republic in the early hours of Thursday, 7 September, and by midnight on the same day it had reached the south-eastern Bahamas. The centre of Hurricane Maria also moved close to the northern coast of the Dominican Republic. This occurred between the night of Wednesday, 20 September and the morning of Friday, 22 September, when it approached the southernmost tip of The Bahamas. The centres of both hurricanes did not directly strike the Dominican Republic, but the associated cloud cover, strong winds and heavy rainfall particularly affected the eastern, northeastern and northern parts of the country as well as the Cibao Valley. It was important to note that the early weather warning, which is part of the National Plan and is normally issued between 60 and 72 hours prior to possible impact, was issued 96 hours in advance in the case of Hurricane Irma. This allowed the warning to be given on a Sunday; had the early weather warning been given the following day, there would have been a delay in the dissemination of the relevant information through the media.

It was also noted that for Hurricanes Irma and Maria, in addition to the real-time and prediction tools normally used, the Flash Flood Guidance system was tested. This system was currently being developed in the Dominican Republic with the assistance of the World Meteorological Organization and the Hydrologic Research Center in San Diego (California).

According to reports from the Emergency Operations Centre, the provinces most affected were in the eastern, northeastern, central and northern parts of the country and included La Altagracia, El Seibo, Hato Mayor, Samana, Maria Trinidad Sánchez, Santiago, Puerto Plata, Monte Cristi, Dajabon, Duarte, Espaillat, Monte Plata and Romana.

Preliminary reports indicated that the impact of Irma was such that 15,829 people were directly affected, 1,885,696 people were indirectly affected, 108 homes were affected, 62 aqueducts were affected and 830 electrical circuits were rendered inoperable; with respect to Maria, 1,752,415 people were directly affected, 2,628,623 were indirectly affected, there were two injuries and two fatalities, 73 communities were cut off, 14 bridges were affected, five roads were damaged, 1,573 homes were destroyed, 10,636 homes were flooded, 128 aqueducts were affected, nine irrigation districts were affected, 83 schools were affected and 4,500 tourists were displaced.

3.2.20 El Salvador reported that Tropical Storm Selma circulated off the Salvadoran Pacific coast and brought large amounts of humid air and clouds across the country. This caused moderate rainfall during the night of Friday, 27 October and heavy rainfall in the morning of Saturday, 28 October. The highest rainfall totals during the event were 194 mm at the San Miguel volcano, 115 mm in San Vicente, and 111 mm in La Cañada, in the department of La Unión. Winds were strong to very strong in coastal areas and in the volcanic mountain range in central-eastern El Salvador, as illustrated by the reported cases of fallen trees and damage to roofs and houses. It is estimated that the winds reached around 9 to 10 on the Beaufort scale, that is, 75 to 102 km/h. The highest wind recording on 27 October was 26 km/h at the Monseñor Romero International Airport weather station; on 28 October, it was 32 km/h at the Acajutla weather station. According to data from Civil
Defence, three islands – La Pirraya, San Sebastián and Rancho Viejo – were severely damaged by Tropical Storm Selma. Overhead power cables were damaged, a total of seven roads were affected, more than 100 trees were damaged in various locations and three fishermen went missing.

3.2.21 France said that in the Antilles, September was an exceptional month in more than one respect. It was the first time since 1850 that three major hurricanes threatened and impacted the Antilles arc in a single season. Even more exceptional was the fact that this incredible cyclonic activity was concentrated in a period of two weeks with two category 5 hurricanes: Irma hit the north of the Antilles arc on 5 and 6, José passed close by on 9 September and Maria crossed the middle of the Lesser Antilles on 18 and 19 September.

3.2.22 Guatemala mentioned that the rainy season set in May as a result of the activation and location of the intertropical convergence zone (ITCZ) and constant easterly waves. Weak trade winds throughout most of the year caused these constant easterly waves and low-pressure systems that brought large amounts of rain during the wet season. The heavy rainfall in May and June meant that the country was very vulnerable to landslides and mudflows.

The formation of Tropical Storm Cindy before it went out across the Gulf of Mexico indirectly caused continued rainfall as the ITCZ moved nearer. This resulted in a landslide in San Pedro Soloma, Huehuetenango, a department on the border with Mexico.

The Guatemalan National Institute of Seismology, Volcanology, Meteorology and Hydrology (INSIVUMEH) issued special bulletins to provide the population and the Coordinating Agency for Disaster Reduction (CONRED) with information about the heavy rainfall.

In early August, the formation of Tropical Storm Franklin caused heavy rainfall across most of the country.

3.2.23 Haiti reported that none of the tropical cyclones that evolved in the Atlantic and the Caribbean during the 2017 hurricane season posed a direct threat to Haiti in terms of their trajectories. However, two (2) of these major Irma and Maria Hurricanes have affected the north coast of the country.

The powerful category 5 hurricane Irma passed near the north coast of Haiti on September 6 and 7. Resulting in one death, one person missing and 17 others wounded. Twenty-two communes were flooded and 12,539 people were accommodated in temporary shelters. Maria, a category 5 hurricane that weakened to category 3 touched the northern coast of the country on September 21st, killing 4 people including a 5-year-old boy.

Haiti also experienced two major rainy episodes:
There were rains on 15 to 17, which resulted in 14 deaths, including 7 fishermen and there were another 2 fishermen missing. There were rains on 15 to 16 November, which resulted in 5 deaths and over 10,000 homes flooded.

3.2.24 Honduras was directly affected by Nate on 5 October 2017. Nate affected 233 families and 1,044 other persons. There were two fatalities, 200 affected homes, three damaged bridges and 16 landslides. Honduras was also indirectly affected by other tropical cyclones. Franklin, Harvey and Selma caused damage, 6 deaths and more than 300 families were affected.

3.2.25 Jamaica indicated that the country had no direct impact from any of the tropical cyclones in the 2017 Hurricane Season. Of the systems that affected the Caribbean region,
Harvey passed closest to the island in August during the period that it was downgraded to a tropical wave. The island, however, suffered significant flooding in September from the trough generated by Hurricane Irma as it skirted the northwestern Caribbean along Cuba’s coast.

3.2.26 México stated that a total of 39 tropical cyclones developed during the 2017 tropical cyclone season, 20 of which originated in the eastern North Pacific Ocean and 19 in the Atlantic Ocean; these were, in chronological order Beatriz, Calvin and Lidia, and Hurricane Max. In the Atlantic Ocean basin, two cyclones made landfall at the eastern coast of Mexico (Franklin and Katia). The evolution and tracks of the main cyclones were shown and several graphs and pictures were presented.

3.2.27 Nicaragua was affected by Nate in October. Watches were issued and some villages were evacuated. Data were collected in different stations and several casualties were reported. Aside from Nate, there were no other impacts from tropical cyclones.

3.2.28 Panama reported that the hurricane season of 2017 had no direct impacts of a tropical cyclone, however, rains and winds in the mountainous sector affected the western portion of the country mainly the province of Chiriqui.

3.2.29 Saint Lucia suffered minimal physical damage during the 2017 Hurricane Season, however two tropical cyclones affected the island during the months of August and September.

The centre of Tropical Storm Harvey passed about 50 miles south of Saint Lucia on 18th-19th August and the centre of Hurricane Maria passed about 140 miles north of Saint Lucia on 18th -19th September. Watches and warnings were issued for both systems by the Saint Lucia Meteorological Services. Response action was well coordinated and the country was prepared for the passage of both systems. Fortunately the impacts from both systems were similar and were limited to closure of schools for a day and the closure of the airports and the business sector for about half a day because of heavy rains.

3.2.30 Sint Maarten described the complicated situation experienced with the passage of Irma especially the challenges encountered by the Meteorological Department St Maarten (MDS). The report also highlighted the challenges encountered with coordination of watches and warnings among the responsible meteorological services in that region. It stressed the challenge of dealing with the possibility of being impacted by more than one system within a few days and the issues on communication after an impact. Graphs and pictures supported the presentation and major damages and casualties were presented as well as evacuation.

3.2.31 The formation and landfall of Tropical Storm Bret was record breaking for Trinidad and Tobago for reasons different to those of the major hurricanes that impacted our neighbours. It was the earliest storm on record to form in the Atlantic portion of the Main Development Region. It was also the lowest latitude forming storm in the month of June, since 1933. Close to three 3 inches of rainfall was measured at the climatological station of record at Piarco from the evening of June 19th into the predawn hours of June 20th. Large parts of Trinidad and Tobago underwent severe rainfall in the 4 hours between 9:00pm and 1:00am. Several locations exceeded 6 inches, especially in areas in the Northern Range and its foothills. The highest totals were in excess of 7 inches and close to 8 inches in places such as Lopinot and Hollis Square in northeast Trinidad. A large portion of the built and urban environment was seriously impacted with close to a half million persons affected. Based on reports the most severely impacted areas were in south Trinidad. As a result of the extreme rainfall, many persons were affected by flooding and landslides. Two deaths were attributed to Tropical Storm Bret. Thousands of residences, as well as some schools and a hospital were affected, leaving people displaced and some stranded in excess of 3
days. In excess of Nine Million Dollars ($9,000,000.00) in grants were paid by Government to assist citizens in the early aftermath of Tropical Storm Bret. Reanalysis data suggest that Brett affected the region because of a well-established mid-tropospheric ridge that steered Tropical Bret west then northwestward closer to Trinidad and Tobago.

3.2.32 The United Kingdom mentioned the effects of Ophelia, which had undergone extratropical transition by the time it reached the UK and Ireland on 16 October 2017. During Ophelia's status as an extratropical cyclone, the estimated minimum central pressure was 957 mb near southwest Ireland at 0600 UTC on 16th. A gust of 103 KT was recorded at the Fastnet Lighthouse (elevation 656 ft), whilst hurricane-force gusts were recorded across much of Ireland and also in some places across the far west of the UK. Significant storm surge was reported along the southern and southwestern coastal areas of Ireland.

In Ireland, three deaths were attributed, either directly or indirectly, to the high winds from extratropical Ophelia

3.2.33 The United States reported that 8 tropical cyclones affect the country in 2017. The report focused on the three category four hurricanes (Harvey, Irma, and Maria) that made landfall in the United States. These hurricanes caused several hundred direct and indirect deaths in the United States and more than $250 billion in damages, which makes the 2017 season the costliest hurricane season on record in the U.S. Although there was a high number of fatalities, there are no known storm surge-related fatalities (as of this writing) in the U.S. from the 2017 tropical cyclones.

3.2.34 Venezuela noted that during the tropical cyclone season, its eastern region, comprising the states of Anzoátegui, Delta Amacuro, Monagas, Sucre and Nueva Esparta, was directly affected by the second tropical storm of the season, Tropical Storm Bret, on 19 and 20 June 2017. On Tuesday, 20 June 2017, as Bret passed directly over eastern Venezuela (the states of Sucre and Nueva Esparta), the weather radar of the National Meteorology and Hydrology Institute (Instituto Nacional de Meteorología e Hidrología (INAMEH), in Carupano, recorded winds of over 100 km/h. This tropical storm was downgraded to a tropical wave as it passed over the Caribbean Sea to the north of Venezuela on Tuesday, 20 June 2017, at 5 p.m.. In general, the direct and collateral effects of Bret as it passed over and near the eastern part of Venezuela, even when it was a tropical wave, strongly modulated the weather in the Intertropical Convergence Zone, resulting in about one hundred fallen trees, hundreds of affected homes, landslides, overflowing streams and a marked increase in the number of swells, especially on the eastern coast, impacting small vessels in the area.

3.2.35 Spain said that events such as tropical cyclones are not very frequent in its region and that when they occur, they mainly take the form of tropical storms and occasionally hurricanes. In 2017, Hurricane Ophelia approached, but did not make landfall in Spain, but it did cause rough seas, strong gusts of wind and significant swells, and it indirectly caused one unexpected fire in the northeast of the peninsula.

3.2.36 Cabo Verde presented the situation of the country in relation with the hurricane activity over the years.

3.2.37 The Members’ reports submitted to the current session are given in Appendix IV.

3.2.38 Other countries represented at the meeting stated that during the 2017 season they were not significantly or at all impacted by a tropical cyclone.

4. COORDINATION WITHIN THE WMO TROPICAL CYCLONE PROGRAMME
4.1 Dr Peng made a presentation to the Committee on activities under, and those requiring coordination through, TCP. It appreciated the comprehensive presentation, and thanked WMO support to the Committee.

4.2 The Committee was informed by the WMO Secretariat that the EC-69 made a decision (Decision 3, EC-69) about development of WMO Global Multi-Hazard Alert System (GMAS), requesting all WMO technical programmes to contribute to GMAS development.

4.3 The Committee was informed that the Global Guide to Tropical Cyclone Forecasts has been reformatted with more readable and easily printable format. It can be downloaded at https://www.wmo.int/cycloneguide/.

4.4 The Committee was informed that the 9th International Workshop on Tropical Cyclones (IWTC-9) would be held in Honolulu, Hawaii, USA, 3-7 December 2018. The Workshop was intended to aggregate researchers and forecasters in tropical cyclones to interact among them and exchange research results and operational requirements between research and operational communities. Members of the Committee were invited to utilize the opportunity to send their experts and forecasters to exchange and share knowledge and experience with others.

4.5 The Committee was informed that TCP activities during the inter-sessional period were mainly focused on following aspects:
   - Training and Capacity Development
   - Support to Operational Forecasting
   - Global and Regional Coordination of Forecasting Services
   - Support to DRR endeavours associated with tropical cyclones

4.6 The Committee noted TCP’s plan to organize a global technical coordinating meeting on issues related to tropical cyclone forecasting and warning coordination, hopefully back-to-back with IWTC-9.

4.7 The Committee was informed that collaborative efforts were made by the TCP and WWRP for promoting application of research outcomes to operational forecasting within the framework of the Typhoon Committee to implement the Typhoon Landfall Forecast Demonstration Project (TLFDP) including EXOTICCA (Experiment on Typhoon Intensity Change in the Coastal Area), and the Research and Development Project of Understanding and PreDiction of Rainfall Associated with landFalling Tropical cyclones (UPDRAFT).

5. COORDINATION IN OPERATIONAL ASPECTS OF THE HURRICANE WARNING SYSTEM AND RELATED MATTERS

5.1 Mr. Tyrone Sutherland (British Caribbean Territories) served as rapporteur on this agenda item with the assistance of other members of the BCT team. This agenda item is intended to allow Committee members to raise matters that impact on the effectiveness of the Hurricane Warning System.

5.2 The Hurricane Committee Chairman informed the Committee that the Kingdom of the Netherlands made a formal request for the RSMC-Miami to serve as the back-up for watches and warnings for the islands and coastal waters of Bonaire, Saba and St. Eustatius within the Hurricane Operational Plan. USA agreed to the request, which was then endorsed by the Hurricane Committee. The Committee requested that arrangements be formalized before the 2018 Hurricane Season.

6. REVIEW OF THE RA IV HURRICANE OPERATIONAL PLAN
6.1 The Committee reviewed in depth the Operational Plan, taking into account changes and additions that came out from this and the other agenda items. The operational implementation of the GOES-16 and Meteosat 11 satellites, and a change to the reconnaissance aircraft vortex message that would be implemented in 2018 were incorporated into the Plan.

6.2 As one of its first activities, the Hurricane Committee formulated the RA IV Hurricane Operational Plan to define the responsibilities of all the Members concerned to ensure the most effective coordination and cooperation between those Members in the provision of meteorological information, forecasts and warnings of all tropical cyclones affecting the area. It has also served as a valuable source of information for hurricane forecasters in the region and other users, particularly under operational conditions.

6.3 A majority of members asked to retire Harvey, Irma, Maria and Nate from the list of hurricane names for the Atlantic basin due to the numerous fatalities and extensive damage in multiple countries. The retirements of these names were supported by the Committee and Harvey, Irma, Maria and Nate were retired from the list of named Atlantic tropical cyclones. The Committee decided that Harold would replace Harvey, Idalia would replace Irma, Margot would replace Maria and Nigel would replace Nate.

7. REVIEW OF THE COMMITTEE’S TECHNICAL PLAN AND ITS IMPLEMENTATION PROGRAMME FOR 2018 AND BEYOND

The Committee recommended to the President of RA IV that the updated RA IV Hurricane Committee’s Technical Plan and its Implementation Programme (see Appendix VI) be approved.

8. ASSISTANCE REQUIRED FOR THE IMPLEMENTATION OF THE COMMITTEE’S TECHNICAL PLAN AND STRENGTHENING OF THE OPERATIONAL PLAN

8.1 The Committee expressed its satisfaction that WMO, through the Development and Regional Activities Department (DRA) with the support of the WMO Office for North America, Central America and the Caribbean (NCAC), has continued the development of technical cooperation activities to ensure cost-effective services to Members. The NCAC Office has also provided support to regional activities and assisted in the implementation of WMO Programmes in the Region.

Regional Activities

8.2 During 2017, and within the context of the agreement between the WMO and the Government of Mexico, WMO continued providing assistance to support the National Water Commission (CONAGUA) in the execution of PREMIA (Strengthening Integrated Water Management in Mexico) and MOMET (Modernization of the NMS of Mexico) projects.

8.3 The Directors of Ibero-American NMHSs continued to support activities in RA III and RA IV with the implementation of its action plan for the period 2014-2017. The main lines of action of the three-year plan include: institutional strengthening of NMHS and resource mobilization, development of climate services through pilot projects, education and training and development of subregional virtual centres for the prevention and monitoring of extreme events.

Training
8.4 The RA IV Workshop on Hurricane Forecasting and Public Weather Services took place in Miami, U.S.A, from 26 February to 9 March 2018. This very important workshop is organized on an annual basis at the National Hurricane Centre in Miami, USA, with strong support of WMO and the U.S.A.

8.5 WMO, through the trust fund from Spain, continued to support several activities during 2017, including courses on automatic weather stations maintenance, data processing, climate change, administration of meteorological and hydrological services, flood management, seasonal forecast, hydrology, statistic forecast tools, use of forecast products and satellites and other topics. Additionally, a series of seminars and workshops were also supported especially in hydrological forecast, seasonal forecast, coastal flooding, and telecommunications interaction. Several countries in RA IV have already benefited from the open source MCH information (database) system provided by the Conference.

8.6 The Master’s Degree Programme in Hydrology, with strong distance and computed aided learning components, has continued with great success at the WMO/RTC of Costa Rica, with the participation of students from RA IV countries.

Assistance to NMHS

8.7 The "Haiti Weather Systems Programme – Climate Services to Reduce Vulnerability in Haiti" project, funded by Canada, continued to be implemented. The five-year project aims to develop the capacity of the National Meteorological and Hydrological Services (NMHS) of Haiti to deliver Early Warnings and also general weather, climate and hydrological services to the people of Haiti. Updated activities of the project up to February 2018 include:

- The construction of the Hydrometeorology Unit (UHM) building was completed in May 2017. The building was inaugurated on 26 May 2017 by the WMO Secretary-General, Prof. Petteri Taalas; Haiti’s Minister for Agriculture, Natural Resources and Rural Development (MARNDR), Mr. Carmel Andre Beliard and the Ambassador of Canada in Haiti, Ms. Paula Cadwel. Connection to electricity and drinking water networks were carried out using MARNDR budget. The MARNDR also proceeded with the hiring of administrative personnel.

- In September 2017 a contract was signed with Météo-France International for the provision of a technical assistance package that includes the equipment and software necessary to generate the weather forecasts, the issuance of alerts and the dissemination to the general public. It is expected that this activity will be completed in September 2018.

- Maintenance and conservation works are carried out on a network of 6 automatic stations installed during 2017 with collaboration of INSMET (Cuba).

- Regarding training activities during 2017, language courses for UHM staff were continued.

- An intense advocacy work has been carried out with the Haitian authorities in order to assure the UHM of the human and financial resources necessary for the development of its functions. Important coordination was carried out with partner agencies and organizations, such as the WB.

- All project activities and the sustainability of the respective achievements depend to a large extent on the active participation and support of the Haitian Government.

8.8 The Spanish Agency for International Development Cooperation (AECID), with funds provided by the European Union and with the Spanish Meteorological Agency (AEMET) as
implementing institution, has secured funds for the installation of a lightning detection network in Central America. The bidding process has been completed and the contract awarded to TOR. Installation will begin within the next few months.

VCP Projects

8.9 During 2017 WMO continued providing assistance to NMHSs through the VCP Programme. One request was received from NMHSs in the region. A list of VCP projects carried out for 2012 through 2017 related to the Members of RA III and IV is given in Appendix VII.

9. OTHER MATTERS

9.1 The Hurricane Committee was given a briefing on the progress being made towards the development and implementation of the WMO Severe Weather Forecasting Demonstration Project (SWFDP) in parts of the Caribbean. The Regional Subproject Management Team (RSMT) for the SWFDP held a meeting on the margins of the Hurricane Committee session, co-chaired by Mr Tyrone Sutherland and Mr Jean-Noel Degrace. The two Co-Chairs reminded the Committee that the Management Group of RA IV had decided that the WMO SWFDP in the Caribbean would cover the Eastern Caribbean islands from Trinidad in the south to Puerto Rico in the north, with special arrangements for Haiti. Mr Jean-Noel Degrace informed the Committee on the progress made at the Regional Forecast Support Facility (Météo-France Martinique) to develop the WEB-Based platform for data/products sharing, to produce severe weather guidance and to ensure real time coordination. A pre-operational testing phase could start within 6 months. The SWFDP was being pursued with an aim, among others, to foster greater collaboration among National Meteorological Services and Disaster Management Agencies, particularly when one considered that many episodes of severe weather and thus potential natural disasters were not always the result of a direct impact of tropical cyclone and can happen all year long.

9.2 This side meeting of the RSMT was the first since the Expert Group met in May 2017, as referred to in paragraph 9.1 above. As part of the SWFDP development, a preparatory training workshop was held for the NMHSs/NMCs of participating island states/territories to develop capacity of their forecasters on numerical weather prediction (NWP) interpretation and use in severe weather forecasting and delivery of public weather services (PWS). The training workshop was held at The Caribbean Institute for Meteorology and Hydrology (CIMH) in Barbados from 12-15 March 2018. The workshop was attended by eleven participants from Antigua and Barbuda, Barbados, Dominica, Grenada, Martinique, St. Kitts and Nevis, Sint Maarten, St. Vincent and the Grenadines, and Trinidad and Tobago, with a forecaster from Curaçao attending as an observer. There were lectures from Météo-France, RSMC Miami, WMO -PWS Division and CIMH.

Regional WIGOS in RA IV

9.3 Dr Riisjøgaard presented the WMO Integrated Global Observing System (WIGOS), including the Rolling Review of Requirements (RRR) and the supporting Observing System Capabilities and Review (OSCAR) databases, focusing especially on OSCAR/Requirements and OSCAR Surface. He then introduced the NWP-based pilot project of the WIGOS Data Quality Monitoring System and highlighted the relatively poor exchange of surface pressure data shown by this system over large parts of RA IV. Finally he presented the current implementation status of Regional WIGOS Centers, which were crucial to support the national WIGOS implementation and operational uptake of WIGOS systems and thereby help improve the network performance and overall compliance of WMO Members with WMO
regulatory and guidance material. It was pointed out that RA IV is still looking for a way forward on its implementation of the RWC concept.

**Hurricane forecaster competencies and training within RA IV**

9.4 Keithly Meade presented the hurricane forecaster competencies and training within RA IV. Kathy-Ann Caesar (CIMH) described the standards and requirements in RA IV as presented in the document that requires feedback from users. The newly published Guide to Competency (WMO-No. 1205) covers the competencies and their implementation. Competencies are a combination of skill, knowledge and behavior which were explained in a WMO Competency Framework. The speaker described the initial thoughts on RA IV categories of tropical cyclone forecasters (three categories of tropical cyclone forecaster (TCF): hurricane specialist forecaster, regional forecaster, and forecaster in the non-forecast office) and the possible framework. For each first level competency there is a second level competency which provide detail skills, knowledge, and behaviours. She mentioned the need for focal points in Spanish, French and English to assist in completing the formulation of the hurricane forecaster competencies and the need to get feedback for other members.

Already Antigua and Barbuda, Canada, Météo-France, Costa Rica, Cayman Islands, and NHC representatives have volunteered to assist.

9.5 The representative of Cuba expressed his concern that the United States of America closed its consular activities in their Embassy in Havana and, as a result, it may become difficult to have candidates from Cuba to participate in some TCP activities held in the USA. He requested that measures could be considered in order to help candidates from Cuba participate in activities such as the WMO Hurricane Forecasting Workshop at the National Hurricane Center in Miami, FL. The WMO representative at the session mentioned that efforts would be made from the Secretariat to ensure the continuous participation of Cuban candidates in TCP activities to be held in US.

**Update on RSMC Miami products and services and a look toward the future**

9.6 Mr Daniel Brown presented an update on RSMC product changes planned for 2018, including the operational implementation of the Time of Arrival of Tropical-Storm-Force Winds graphics. The new features in watches and warnings and RSMC products used to improve the communication of tropical cyclone hazards were provided. The questions of whether 48 hours lead time was enough for Potential Tropical Cyclone advisories and whether the term Potential Tropical Cyclone was understood by the media and public. In English and French there has been a concern over the term “cyclone”. In Spanish the word “Potential” is not well understood. Members were encouraged to provide additional feedback on these topics for consideration for future changes to these terms.

RSMC Miami presented that public advisories would now discuss forecast information beyond 48 hours, and the RSMC would begin issuing 48-h hurricane-force wind radii forecasts in 2018. The new format of public advisory was presented.

The last change noted was an update to the reconnaissance aircraft Vortex Data Message (VDM). The changes are expected to enhance the utility of the VDM by including important parameters previously not provided, or provided optionally in the comment section, and improving the overall organization of the message. These changes were reflected in the Operational Plan.
Members were reminded that the 2018 Hurricane Preparedness Week would be 6-12 May, and that outreach material was available on the U.S. National Weather Service and RSMC Miami webpages.

Mr Brown concluded the discussion by mentioning new online webinars and trainings and the new Florida International University Spanish-language hurricane website (https://huracanes.fiu.edu/). He also presented some future potential product enhancements and the need for external contribution of ideas and feedback.

**Update of Storm Surge demonstration Project (NHC)**

9.7 Mr Jamie Rhome of RSMC Miami gave an update of the WMO Storm Surge demonstration project within RA-IV.

Mr Rhome discussed the need and origins of the demonstration project and presented the 2017 season in review successes to use storm surge watches and warnings. He demonstrated that no casualties have been registered in the United States due to storm surge. It was stated that evacuation decision-making was improved due to the storm surge advisories.

He presented the CIFDP-C in Dominican Republic and its extension to the Caribbean. The Mexico Storm Demonstration Project was also presented as well as the SLOSH Basin for the Yucatan peninsula that revealed the need for good topographic data.

Mr Rhome showed TanDEM-X data that is from a German satellite, which was break-through data because it was available globally. He presented a comparison of the TanDEM-X data and previously available topographical data. The results demonstrated that the TanDEM-X data was substantially better than existing data (SRTM and ASTER) and close to the level of quality of LIDAR. Given the global coverage of TANDEM-X, this constitutes a huge breakthrough enabling storm surge modeling efforts across the region. TANDEM-X data was also verified with the study region with high-quality surveys.

The initial assessment was very encouraging for the Caribbean, the topography QA/QC was essential and the bathymetric data was already built-in the project.

As per the modeling, leveraging US modeling testbed for Puerto Rico and the Virgin Islands brought down the cost and it was recommended that the existing modeling systems are too expensive (2nd generation wave model for SLOSH significantly reduce costs). Mr Rhome showed the initial results of wave modeling and the Hispaniola Demonstration Project SLOSH grid. Specifically, the 2nd gen wave model matches nicely with SWAN results with approximately 1/12th the runtime. The model coupling and validation continues using data from the 2017 hurricane season and will help ensure that the model is producing the expected results.

Several wave coupling and river coupling methodologies were also presented.

New storm surge training and outreach material was shown and the Committee was informed that existing COMET modules were now available in Spanish and French.

**Resource mobilization**

9.8 Dr Peng presented the TCP budget/expenditures in the past three years for Hurricane Committee activities in Region IV and invited the Members of the Committee to consider the possibility of contributing in-kind to the TCP activities.
9.9 The Committee appreciated WMO Secretariat for sharing the information, and recognized budget constraints that TCP had encountered, but reiterated the importance of the Committee in its effort to reduce damages and losses by hurricanes in the region. It agreed to work together with WMO Secretariat to continue the success of the Committee. Official Communication between WMO Secretariat and some Members concerned would be followed up after the session.

**IOC/ICG Tsunami Caribe**

9.10 Colonel Patrick Tyburn, Chair of the Working Group 4 for ICG/Caribe, presented the tsunami and other coastal hazards for the Caribbean and adjacent regions (CARIBE EWS). Over the past 500 years more than 75 tsunamis have killed 4484 people, being a major threat. He presented the different working groups composing ICG/Caribe. US PTCWC is the only Caribe EWS Tsunami Service Provider.

**Working Group on Hydrology**

9.11 Mr José Alberto Zúñiga Mora presented the work of the Working Group on Hydrology, which met in 2015 for the last time, was re-established during the seventeenth session of Regional Association IV and was included in the Operational Plan. The main terms of reference and the new work programme of this Group, defined in January 2018, were highlighted. The participation of Permanent Representatives and Hydrological Advisers was requested in the programmed activities. The speaker presented the requirements for seasonal precipitation estimates and quantitative rainfall forecasts during extreme events for flood modelling. Finally, extreme events have an impact on precipitation and flow records, and in the case of dams, the design values could be modified.

**WMO GMAS (Multi-Hazard Alert System) and possible proposal for GMAS-Caribbean**

9.12 Dr Peng presented to the Committee WMO Global Multi-Hazard Alert System (GMAS) in relation to tropical cyclones. He first introduced the history and background of GMAS. He informed the Committee that WMO planned to develop GMAS which would become a WMO common technical platform to better serve the Members and to meet the requirements of international communities, in particular in the areas of UN relief after disasters, UN humanitarian activities and UN crisis management and operations. Further TCP planned to contribute to the development of the GMAS through integrating the existing tropical cyclone forecasting and warning information into GMAS. The Committee was requested to provide necessary support and assistance when needs arise during GMAS development.

9.13 The Committee was invited to consider to develop/establish GMAS in the region (coded as GMAS-Caribbean), to establish a team for that purpose, and as an initial step, to collect/aggregate authoritative hurricane forecasting and warning by e.g. email or CAP-enabled messages issued by NMHSs in RA IV. It discussed the matters, and agreed to bring the issues to the Management Group of RA IV for decision.

**Satellite**

9.14 RSMC Miami reminded the committee that the GOES-16 satellite is now the operational GOES-East satellite and that the GOES-17 satellite was successfully launched in March 2017. Experimental data from GOES-17 should be available later this year.

The committee expressed concern regarding the potential loss of NOAA NESDIS SAB Dvorak satellite intensity estimates. These estimates are used by RSMC and RA-IV Member States to estimate the strength of Atlantic and eastern Pacific basin tropical cyclones. These
intensity estimates are extremely important when reconnaissance aircraft data are unavailable.

The committee also expressed concern over the lack of availability of NOAA NESDIS tropical cyclone satellite “floater” loops. With the operational implementation of the GOES-16 satellite, these loops became unavailable. The loops are used by meteorological and emergency management services throughout the RA-IV region. The potential loss of these loops for the 2018 hurricane season could adversely affect tropical cyclone forecasting and response throughout the region.

*Upper Air Status of the Cooperative Hurricane Upper Air Stations (CHUAS) Network in the Caribbean (NWS)*

9.15 Dr Lixion Avila, on behalf of Mr Hiram Escabi the Upper Air Program Manager for the United States National Weather Service (NWS), provided a presentation concerning the Cooperative Hurricane Upper Air Stations (CHUAS) network for the Caribbean.

This presentation provided information concerning network background, history, stations, certified upper air observers, maintenance, station inspection, station report, radiosonde soundings, new ground system, radiosondes, equipment upgrade, status of equipment upgrade, GRAW systems installed, GRAWMET software, balloons, timeliness and future goals of CHUAS radiosonde soundings. The speaker said that there was an increase in model skill during hurricanes with the additional upper air data and expressed his gratitude to the country for the extra work.

*CREWS Caribbean Project and the "Lessons learnt on EWS following the Caribbean 2017 Hurricane Season"*

9.16 Mr John Harding presented the CREWS initiative, which supports LDCs and SIDS to significantly increase the capacity to generate and communicate effective, impact-based, multi-hazard, gender-informed early warnings to protect lives, livelihoods, and assets. Ms Lina Sjaavik exposed the initiative in the Caribbean, where CREWS aims to assess the effectiveness of Caribbean early warning systems by identifying critical gaps during the 2017 hurricane season in the areas of meteorology and hydrology, disaster management, and gender, to reassess and validate priority investments for CREWS and other initiatives.

*Acknowledgement of Retiring Members*

9.17 The Hurricane Committee bade farewell to Mr Tyrone Sutherland, the Permanent Representative of the British Caribbean Territories with WMO and a long-time member of the Hurricane Committee, who was scheduled to retire before the next session of the Committee. The Meeting thanked him for his dedication and outstanding contribution to the work of the Committee over the years that translated into continually improving warning system for the safety and wellbeing of the citizens of the Region and wished him well in his future endeavours.

**10. SCIENTIFIC LECTURES**

The following scientific lectures were given:

High resolution observations from space – Synthetic Aperture Radar (SAR), presented by Mr Thierry Dupont on behalf of Dr Alexis Mouche, IFREMER, France.
The following recommendation was adopted:

Special acquisition plans during IRMA, JOSE and MARIA having demonstrated the high value of kilometric-scale information provided by Sentinel-1 SAR data, HC-40 recommends that these data are made available to help monitor critical aspects of the TC structure (wind radii, maximum wind, eye diameter, etc...).

- NWP-AROME, presented by Mr. Thierry Dupont, Météo-France Martinique.
- Tropical cyclone and climate change, presented by Fabrice Chauvin, Météo-France Toulouse
- Focus on lead time and anticipation (Disaster Risk Management), Colonel Gérard Ré(EMIZA)

11. DATE AND PLACE OF THE FORTIETH SESSION

The Committee was informed that Curaçao would be happy to host the forty-first session of the RA IV Hurricane Committee in 2019.

12. CLOSURE OF THE SESSION

The report of the fortieth session of the Committee was adopted by the Committee and approved by the President of RA IV. The meeting ended at 12:30 pm on 13 April 2018.